

The Importance of Vaccinations in a Global Society

An Honors Thesis

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Abstract

This paper discusses the complicated circumstances surrounding an individual's ability or choice to vaccinate either themselves or their children. Included is a section with a condensed history of vaccines, as well as a section describing their mechanism of action – providing background on how vaccines work within the human body. This paper also looks at factors such as a patient's relationship with their primary care provider, their socioeconomic status, education level, and even geographic location to nearby resources and how each impacts their ability to vaccinate. Incorporated within this paper are also the arguments of those opposed to vaccines and a rebuttal from myself arguing their importance.

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Ball State University will forever hold an incredibly special place in my heart. Thanks for the ride of a lifetime.

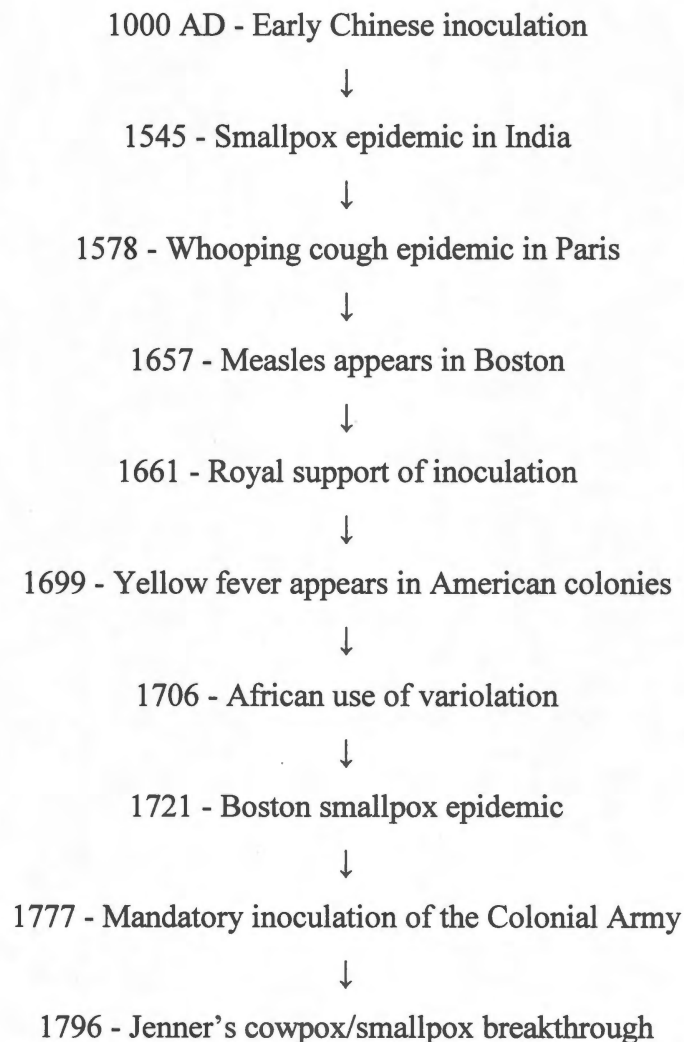
Introduction

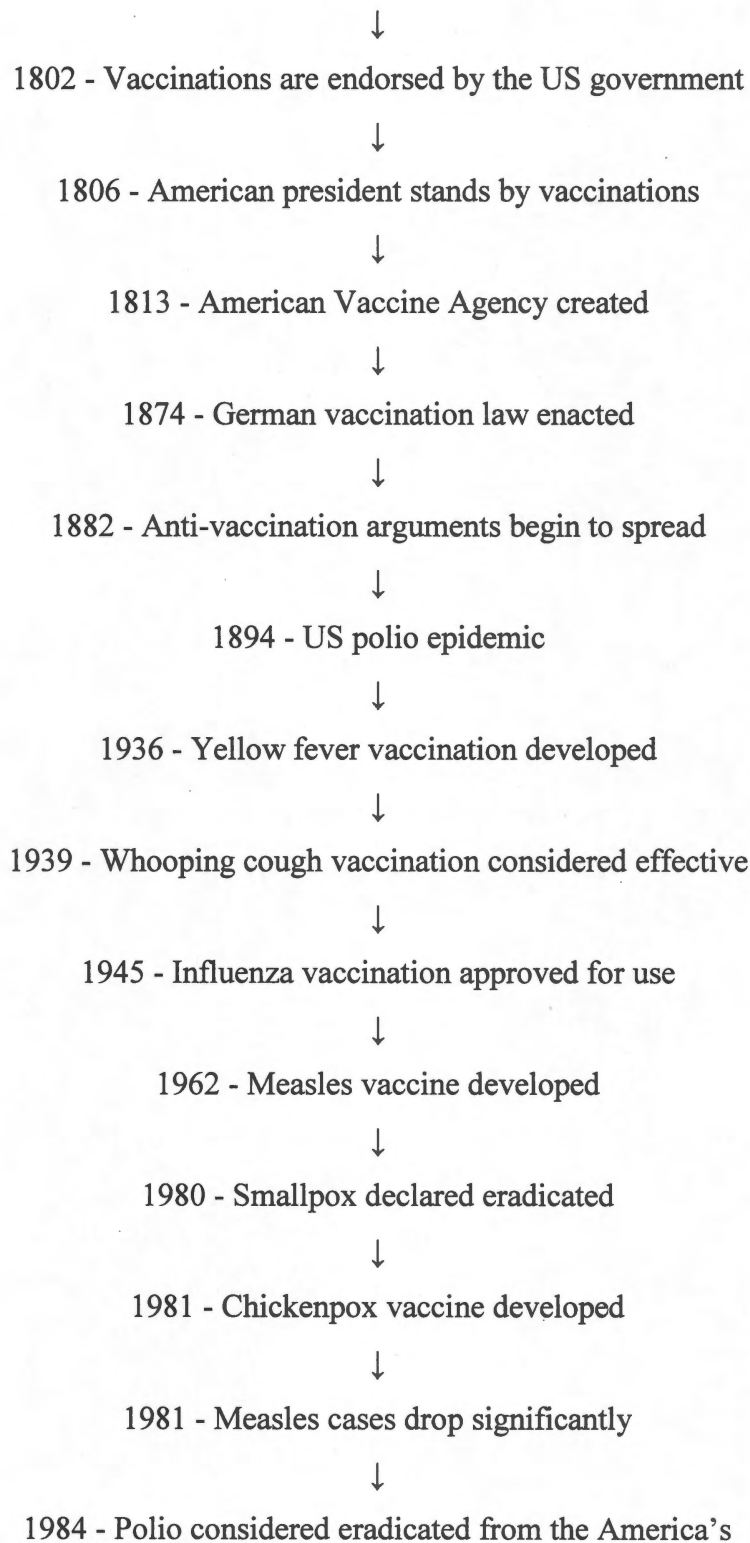
As it's come to medical and scientific advancements that have developed in the past one hundred years, little have been as controversial or heavily scrutinized as vaccinations. Since the development of vaccinations from their primitive form of variolation - where infectious agents such as blood or other exudates were taken from an infected host and transplanted into a normal host in the hopes of forming an immune complex to the pathogen - the immunizing agents have faced heavy backlash and strong opposition. This is due in part to studies that have wrongfully informed individuals by "proving" negative side effects of vaccinations, particularly within children. The greatest example of this was a study released in the late 1990's where an apparent link was found between the development of autism and the administration of vaccinations.

In addition to false studies and reports of the effects of vaccinations on those who are administered them, there are a plethora of additional obstacles that stand in the way of individuals having adequate access to vaccines. Issues such as a patient's relationship with their primary care provider, their socioeconomic status, education level, and even geographic location to nearby resources are all restrictions some face. In looking at all of this, one can see a tremendous need and pressure to eliminate these obstacles, as they not only are keeping individuals from preventive medicine but are also affecting society as a whole by placing a small group of individuals at risk of developing near-extinct diseases. Not only is it important for these restrictions to be eliminated, but it's also important that individuals are educated about the benefits of vaccinations, disproving the myths and so-called "facts" that have been purported to be true by opponents in recent years. It's important that individuals see the benefits of vaccinations and how our society today would be much different if it weren't for them.

History and Timeline

The history surrounding vaccinations is one that's a bit more complicated than many other medical advancements - particularly because of the way in which it's evolved and the impact it's had in the role of public health. From it's earliest form of variolation, vaccines have developed into a much safer and effective form of medical intervention than it previously was. The first time anything was created with any semblance to vaccinations was around the time period of 1000 AD when the Chinese began inoculating against smallpox - a disease that wiped out an enormous number of individuals. The remaining history and advancements of vaccinations are listed in the timeline below:





(The History of Vaccinations. 2016.)

From looking at the complicated and lengthy timeline listed above, it can be seen that the history of vaccinations isn't one that's developed in the past one hundred years alone, nor has it been one where it's been accepted by the general public with relative ease. It's taken *hundreds* of years for vaccinations to have grown into what they are today and to have made the tremendous impact that they have on the entirety of our society's public health. In looking at the last fifty years in particular, the eradication of several illnesses has been observed - particularly smallpox and polio. Yet in addition to that, the development of vaccinations against more common illnesses such as chicken pox and influenza have had just as beneficial of an impact, as each have decreased the prevalence rates of some of the more common illnesses to be found within our society.

Mechanism of Action

Before delving into the mechanism of action for vaccinations, it's important to establish the differences amongst different types of vaccination and how each differs from the next in creating various forms of immunization. The original form of vaccination was known as variolation. In looking at the timeline above, smallpox was a disease - one of the first of its magnitude - to sweep across multiple continents in epidemic proportions. The creation of variolation was done in the hopes of stopping such a destructive disease in its tracks. The way in which it did so was much like vaccinations, though in a much cruder fashion. Infectious matter would be taken from an individual - in this example, a smallpox patient - and placed directly into a healthy individual. In doing this, individuals were able to "produce a mild form of the disease and give the person immunity from severe illness" (Inoculation. 2015.). While this form of vaccination was eventually outlawed by most European countries and later the American colonies because of the harmful impact it created in making a individual *more* susceptible to the spread of infections through the use of nonsterile injections of material into their bodies, it was nonetheless one of the first times an effort was made to be more *proactive* rather than *reactive* in fighting the spread of illnesses.

The form of vaccines that we know today didn't come into existence until the late 1700's and into the early 1800's, although there were several forms of vaccinations leading up to those time periods. A name one needs to be familiar with when researching vaccinations is Edward Jenner, who many consider the father of modern day vaccinations. Jenner's research into vaccinations began after observing dairymaids who had been infected with smallpox earlier in their lifetimes who were never reinfected with the virus from that point onward. How was it that those maids who work with cows on a daily basis - many of whom were infected with cowpox, a

form similar to smallpox - would never become sick with such a virus again? His research looked into how, “cowpox not only protected against smallpox but also could be transmitted from one person to another as a deliberate mechanism of protection” (Stefan Riedel. 2005.). In conducting his research and gaining the data and facts necessary to make a firm statement, Jenner inoculated a young boy with pus from a woman infected with smallpox and observed for a reaction. The boy developed a mild-grade fever and general malaise in the days following and recovered within nine days. Jenner inoculated the boy once more following this, only to have nothing occur - a successful vaccination. Jenner postulated this in a booklet he authored titled “An Inquiry into the Causes and Effects of the Variolae Vaccinae, a disease discovered in some of the western counties of England, particularly Gloucestershire and Known by the Name of Cow Pox.” In the years that followed his discovery, public support for variolation grew tremendously, especially after it was endorsed by the United States federal government in 1802 and after the creation of the American Vaccine Agency in 1813. Not only was there research to prove the efficacy of vaccinations, but individuals were personally impacted by the immunizing agents in preventing the spread of deadly diseases.

In looking at the mechanism of action for vaccines, it's important to establish that there are three different groups of vaccinations – attenuated, inactivated, and toxoid vaccinations. Attenuated vaccines - which are more commonly what individuals in today's society are vaccinated with and will be our primary focus in this section - are comprised of “weakened versions of the pathogens; these mimic the kind of protective immunity induced in people who survive live infections” (Bali Pulendran, Rafi Ahmed. 2011.). When an individual is vaccinated with a weakened strain of an infectious agent, it allows the body time to build up an immune response to a level that can simulate a healthy immune response without allowing a full infection

to develop. When this happens, memory T-cells are created. T-cells are a vital part of the human immune system, helping out largely in the humoral - or blood – and cell-mediated responses to an individual's immunity. When an individual is exposed to an infectious agent, the body generates an immune response to that agent, mainly in the accumulation of T-cells. As the body fights the infection and returns to a normal state of homeostasis, the body creates memory T-cells - cells that are specific to that infection the body just encountered and cells that can be used in fighting future infections of the same type and strain. As an individual becomes immune to different strains of disease, not only are they kept from becoming debilitatingly sick to the same strain again, but they're also given the ability to generate immune complexes that will keep them from developing illnesses to similar strains of the same pathogen in the future.

Statistics

While there are plenty of sources that can be used in proving the efficacy of vaccinations and the impact they've had on public health, statistics are often what prove their impact best. In one hundred percent of the cases in which a vaccine has been created for a particular disease process, there has been a likewise decrease in that disease's prevalence and incidence rate. The only times in which there have been an *increase* in incidence rates of a disease to which a vaccination is available have been those times when there's been a *decrease* in the vaccination rate for that particular disease - once again pointing to the efficacy of vaccinations within our society today. The table below provides much more detailed information surrounding the rates of vaccination and the impact they've had on disease rates within America since 2010.

Disease	Pre-Vaccine Era Estimated Annual Morbidity	Most Recent Reports or Estimates of U.S. Cases	Percent Decrease
Diphtheria	21,053	12	>99%
Hepatitis A	117,333	3,473	98%
Hepatitis B (acute)	66,232	19,764	70%
Measles	530,217	667	>99%
Meningococcal disease	2,886	433	85%
Mumps	162,344	1,223	>99%
Pertussis	200,752	32,9712	84%
Pneumococcal disease (invasive, <5 years of age)	16,069	1,900	88%
Polio (paralytic)	16,316	02	100%
Rotavirus (hospitalizations, <3 years of age)	62,500	12,500	80%

Rubella	47,745	62	>99%
Smallpox	29,005	02	100%
Tetanus	580	252	96%
Varicella	4,085,120	151,149	96%

(Vaccines Work!. 2015.)

The Opposing View

As with any controversial subject, it's important to acknowledge the viewpoints of the opposing side and the beliefs they hold. While the majority of individuals in today's society are vaccinated against many of the above illnesses, there are a small group of individuals who have refused vaccination. A statistic provided by the World Bank shows that ninety-one percent of individuals in the United States today have their children – ages twelve to twenty-three – vaccinated before twelve months of age (Immunization, measles (% of children ages 12-23 months). 2015). In looking at this statistic, one out of ten individuals choose not to vaccinate their children. The items below are some of the reasons these individuals oppose doing so.

Vaccines can cause serious and sometimes fatal side effects

Since a study released in the 1990's, one of the largest fears surrounding vaccinating children has been that of an apparent link between vaccinations and autism. Multiple sources arguing against the vaccination of children cite that vaccinated children are oftentimes more chronically ill than those children who aren't. Illnesses they argue vaccinated children are at risk of developing include autism, ear infections, asthma, allergies, and ADHD. Of course, many of these studies have no reputable studies to back these claims up.

Vaccines contain harmful ingredients

According to the website "Home Economist," an article they've published claims that the following ingredients are found in vaccinations:

"MSG, antifreeze, phenol (used as a disinfectant), formaldehyde (cancer causing agent and used to embalm), aluminum (associated with Alzheimer's disease and seizures), glycerin (toxic to the kidney, liver, and cause lung damage, gastrointestinal damage and death), lead, cadmium, sulfates, yeast proteins, antibiotics, acetone (used in nail polish remover), neomycin and streptomycin. And the ingredient making the press is thimerosal (more toxic than mercury, a preservative still used in many vaccines, not easily eliminated, can cause severe

neurological damage as well as other life-threatening autoimmune disease). These vaccines are grown and strained through animal or human tissue, like monkey and dog kidney tissue, chick embryo, calf serum, human diploid cells (the dissected organs of aborted fetuses), pig blood, horse blood and rabbit brain” (Six Reasons To Say NO to Vaccination. 2010).

Vaccines are unnatural, and natural immunity is more effective than vaccination

Here again, the argument is that vaccinations contain far too many toxins and chemicals for their action to be considered “healthy or natural.” Opponents contend that with all of the negative additives within vaccinations, “their unnatural way of introducing disease directly into one’s blood stream actually decreases cellular immunity, which is more critical for one’s immune system” (Goldstein, M. 2014).

Obstacles to Receiving Vaccinations

While there are some problems in the medical world that are single-faceted in their ability to be solved, there are a great number of factors that play into an individual's ability to receive vaccinations. Among these are a patient's relationship with their primary care provider, education level, socioeconomic status, overall opinion of vaccinations, and geographic location. All of these are discussed in further detail below.

Relationship with Primary Care Provider:

A mother's access to a personal doctor has been associated with a 45% greater chance of vaccine administration, a study titled, "Differences in Human Papillomavirus Vaccination Among Adolescent Girls in Metropolitan Versus Non-metropolitan Areas: Considering the Moderating Roles of Maternal Socioeconomic Status and Health Care Access" found (Monnat, S. M., Rhubart, D. C., & Wallington, S. F. 2015.). Within this finding should be considered a woman's overall level of trust and rapport with their doctor. The study suggested that those mothers in low-SES and who live in rural areas have a more traditional patient-doctor relationship, where the doctor is viewed as more of an authority figure. This is in contrast to those in low-SES who also live in urban areas who - findings show - have significantly lower rates of trust in their physician than those in rural areas (Monnat, S. M. et. al. 2015.). Factors to be considered in looking at this are that those in rural areas are more likely to have had the same doctor for a longer period of time than those women in metropolitan areas. This impacts how much weight a woman places upon a physician's opinion on whether or not to vaccinate either themselves or their children.

Education Level:

Not surprisingly, in a study looking at socioeconomic factors and racial disparities amongst rates of childhood vaccination, it was found that children living in households, “with greater income and those whose mothers had greater than a high school education were more likely to be up-to-date than children living in households with less income and whose mothers had less education” (Wooten, K. G., Luman, E. T., & Barker, L. E. 2007.). Within this study, it also found that mothers with greater levels of education than those who received a high school diploma or less were more skilled in handling bureaucracies and social systems and more effective in obtaining needed healthcare services when needed. In looking at all of this, it can be seen that not only does an increased level of education also increase the rates of vaccination, but it also impacts levels of care in many facets of health, not just in the ability to receive vaccines.

Socioeconomic Status:

Factors that determine an individual’s socioeconomic status are typically their education level, average income each year, race and ethnicity, and overall background and lifestyle. With so many factors involved, socioeconomic status is one of the more common items that sways an individual’s ability to vaccinate or not. According to a study titled “Socioeconomic status, demographics, beliefs and A(H1N1) vaccine uptake in the United States,” those individuals *most likely* to receive vaccinations are Hispanics living with federal aid, including monthly welfare checks and provided housing (Galarce, E. M., Minsky, S., & Viswanath, K. 2007). The group of individuals who showed the least chance of receiving vaccinations were young white adults ages 30-44 with an education level of a high school degree or lower (Galarce, E. M. et. al. 2007).

This study also took an interesting look at four different subsets of ideas or reasons to why individuals in varying SES fail to get vaccinated. When questionnaires were sent out to

individuals about whether or not they had been vaccinated against H1N1, their results determined which of the following groups they were placed into: (a) will get the vaccine but have not tried yet; (b) have tried to get the vaccine but it has not been available; (c) do not know whether will get the vaccine or not; and (d) will not get the vaccine. As stated above, those in group (a) were mainly of Hispanic descent, living beneath the federal poverty line in rural areas. Interestingly enough, this group of individuals also had the highest rates in beliefs of vaccinations being safe. Those in group (b) were composed of mainly black participants with an education level of a bachelor's degree or less. Participants in group (c) were mostly white with less than a high school degree and who also were living beneath the federal poverty line. Unlike those in group (a), this group also had the highest rates of distrust in the safety and effectiveness of vaccinations. Finally, those in group (d) had varying levels of college education and were aged 45-59, living with no children above the federal poverty line (Galarce, E. M. et. al. 2007). This group of individuals also viewed the flu vaccine to be unsafe.

Overall Opinion of Vaccinations

When it comes to the opinions individuals hold towards vaccinations, oftentimes those opinions revolve around whether or not vaccinations are thought to be safe rather than effective. There have been a tremendous amount of controversial studies released since the inception of vaccinations attempting to disprove both the efficacy and safety of vaccinations, most notably a study released in the late 1990's in which a supposed link was discovered between the development of autism and vaccinations. Such a link was later debunked, but not before creating an incredible amount of uncertainty in the safety of vaccinations. In a study where the perceived safety of vaccines was measured in participants receiving the H1N1 vaccination, those who were most likely to perceive the vaccines as safe tended to be older male participants (Galarce, E. M.

et. al. 2007). In looking at those ethnic/racial groups and their opinions regarding the safety of vaccinations, black participants were most likely to deem vaccines as unsafe. In looking at education level, those with a bachelor's degree or higher were, "69% more likely to perceive the vaccine as safe than those with less than a high school degree," while those living in urban areas were, "35% more likely to perceive the vaccine as unsafe in comparison to those living in rural areas" (Galarce, E. M. et. al. 2007).

Geographic Location:

This was an interesting factor to consider in looking at vaccination rates amongst different groups of individuals. Not only did it look at the length of time it would take to travel to the closest healthcare agency to receive vaccinations, but it also looked at the level of education many in metropolitan and rural areas achieve in correlation with their SES and the impact that plays in receiving vaccinations. A study found that:

"Among low-income girls and girls whose mothers did not complete high school, those in non-metropolitan areas had significantly higher probability of vaccine initiation than those in metropolitan areas. Among high-income girls and girls whose mothers completed college, those in metropolitan areas had significantly higher odds of vaccine initiation than those in non-metropolitan areas" (Monnat, S. M. et. al. 2015.).

This study concluded that findings suggest the need to aide low-SES mothers in metropolitan areas but high-SES mothers in non-metropolitan areas in receiving vaccinations.

Current Programs to Aide in Receiving Vaccinations

While there are a great number of barriers that can stand in the way of an individual receiving vaccinations, there are also a great number of programs that are in place to help an individual with being able to obtain vaccines, regardless of their socioeconomic status or other challenges they may face. One such program is the Vaccines for Children Program, a federally funded program that provides vaccines at zero cost to children of families who qualify. Within this program, the Centers for Disease Control and Prevention will buy vaccines at discounted rates and distribute such vaccines to those who have applied for grants, such as local and territorial health agencies. These agencies will then distribute the vaccines at no charge to healthcare providers to be administered to individuals who qualify (Vaccines for Children Program (VFC). 2014).

Federal healthcare programs are also a source of aid to those with difficulty accessing or paying for vaccinations. Programs such as Medicaid, the Affordable Care Act, and particularly Medicare all include ways for individuals to acquire vaccinations. Within Medicare, if an individual is sixty-five years of age or older or a beneficiary of the program, the entire cost of your influenza, pneumococcal, and hepatitis B vaccinations will be covered (How to Pay. n.d.). Additionally, the Affordable Care Act requires new health plans to pay for preventive services - including vaccinations. It also requires that co-pays and deductibles for these services be eliminated, decreasing the costs an individual has to pay out-of-pocket for what are completely preventive services.

Opinion

In looking at the arguments both for and against vaccinations, a consistent theme that's arisen out of those who are against is that there's a lack of education surrounding vaccines and the way in which they work. Because of misleading studies that have been published in the past, there's still plenty of doubt present amongst our society regarding not only the efficacy of vaccinations but their overall safety. As indicated in table one within this paper, the efficacy of vaccinations is not something that should be doubted. Time and again, rates for disease processes in which vaccines are developed against have shown a dramatic decrease in their prevalence within our society. In regards to the safety of vaccinations, there has been no viable research completed to indicate that there should be a cause for alarm in vaccinating yourself or your children. In fact, it's more unsafe for an individual to *not* get vaccinated than it is to get vaccinated. In addition, the cost benefit to being vaccinated is tremendous. According to the Healthcare Cost and Utilization Project, the average cost per hospital stay for an individual in 2012 was \$10,400 (2014). Compare that with the average cost of \$15 for a vaccination, the evidence is clear: Either spend a good portion of your savings for a hospital stay for illnesses that are completely preventable or spend the equivalent cost of what you spend for a nice dinner to be safe from those same illnesses. Vaccinations are not only effective in defending you against diseases, but they're also cost-effective.

I will say this, however: there are statistics and facts - statistics and facts that are undisputed despite the overarching vaccination debate - that time and again have proven the positive effects of vaccinations. In the 1700-1800's, nearly every individual within America was exposed to measles at some point or another in their life, with thousands each year passing away from the disease. Now, most doctors will never see a case of it within their lifetime of practice.

In the year 1921, 15,000 people died of diphtheria, an astounding amount. Since finding a vaccination for the deadly disease, there's been only twelve reported case within the United States since 2004. In 1964-65, 12½ million Americans were infected by rubella, which also killed 2,000 babies and caused 11,000 miscarriages. In 2010, only nine cases of rubella were reported. While there may be the argument of what's being put within your body when being vaccinated and the "safety risks" that it poses, statistics consistently prove the efficacy of vaccinations nonetheless.

Speaking of what's within vaccinations, the argument of not knowing what's within them and thus doubting their safety because of such could be considered a valid argument and cause for alarm. What with not knowing what composes most of the things that we consume or are exposed to on an daily basis, there's definite reason to research what exactly makes up vaccinations, especially when choosing to vaccinate your own children. However, focusing on the one part of anything that makes up the sum of a whole narrows the ability to see the end product. If you focus on the one preservative within the vaccination instead of the whole - that being a vaccination that has the ability to protect you for the rest of your life - you risk adopting an extremely dangerous mindset. To give you an example, table salt is composed of sodium chloride. Chloride by itself is dangerous and can be potentially deadly, though when combined with sodium is completely harmless and makes up an insane part of our everyday diet. If you're not going to be vaccinated out of fear of the preservatives that are present within a vaccination - preservatives that aren't added out of a whim but which are necessary to keep the vaccination viable until the time of administration - then the things you consume within a day are going to be significantly hampered, as most foods within our diet have some form of preservative within them. If you're going to cut out vaccinations because of the very limited amount of

preservatives that they contain, then you need to cut out everything in your life which contains preservatives.

Finally, arguing to not be vaccinated because of the negative stories and experiences that one hears about vaccinations contradicts reason. The arguments that vaccinations cause ADHD and autism are absolutely untrue and incredibly confounded. The researcher who “proved” the link between vaccines and autism was forced to rescind his study because of its tremendous inaccuracy. Further, for the remaining arguments against vaccinations arguing the reactions some experience when receiving them, here’s an example to think about: If you’re riding along in a car and get into a car accident with both you and your passenger wearing a seatbelt, though you’re the only one who’s left uninjured because of wearing your seatbelt, does that mean that you simply stop wearing seatbelts and encourage others to do the same because your passenger was injured despite wearing their seat belt as well? Does that mean that seat belts are ineffective and not worth investing in? Absolutely not. It means that sometimes events and situations out of our control happen, resulting in negative consequences. Are some people more predisposed than others to having a reaction to vaccinations? Absolutely. However, that predisposition is no different than the same predisposition one has to having a potential allergic reaction to peanut butter or even common seasonal allergies. It gives an individual no reason to argue that – because of one person’s negative reaction to vaccinations that vaccinations as a whole are ineffective or unsafe.

Individuals should have every right to make their own decisions of whether or not to vaccinate either themselves or their children. However, if people were to be educated about the benefits of vaccinations - while also educating them of the risks - people would be able to make a much more informed decision. As with anything in life, you can’t make a fair decision by

simply focusing on the one side of any issue. You have to find that balance. After you've considered both sides of the argument and have looked at all of the facts, the decision you make is then an informed and respected one. However, in the argument of whether or not to vaccine, I'll leave you with this one last remark: There's a reason that diseases which killed millions of people in the past are no longer present within our society today, and it's because of vaccinations, the results of which should not be disputed.

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